PINE ORCHARD HARBOR

BRANFORD , CONNECTICUT

SURVEY

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DIVISION ENGINEER
NEW ENGLAND DIVISION, BOSTON, MASS.

APRIL 4, 1957

24

ARMY - NED BOSTON

NOT FOR PUBLIC RELEASE

SURVEY OF PINE ORCHARD HARBOR

BRANFORD
CONNECTICUT

SYLLABUS

Pine Orchard Harbor at Branford, Connecticut has been improved by local interests to permit shipment of crushed stone by tug and scows at a large saving in transportation cost over the cheapest alternate route. Traffic in the present 12-foot channel is subject to tidal delay which would be eliminated by construction of a 15-foot channel. The desired improvement would provide general navigation benefits to commercial navigation, and as the harbor channel is used by a single shipper, also would provide local benefits. The benefit-cost ratio of the desired improvement is 2.0 to 1.

The Division Engineer recommends authorization of a Federal navigation project at Pine Orchard to provide a 15-foot channel, 100 feet wide from Long Island Sound to the New Haven Trap Rock Company loading basin. The recommendation is subject to the requirement that local interests enlarge the basin to 3.2 acres and maintain it to a depth of 15 feet, make a cash contribution of 40 percent of the construction cost of the Federal project channel, and hold and save the United States free from damages from the improvement.

The estimated Federal cost of the project is $90,000 (March 1957), exclusive of $2,000 for additional navigation aids, with $22,000 annually for maintenance. The non-Federal cost is estimated at $90,000, of which $30,000 is the cost of enlarging the loading basin and $60,000 is the required contribution recommended.

NAVIGATION STUDIES

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NOT FOR PUBLIC RELEASE

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DIVISION ENGINEER
NEW ENGLAND DIVISION
150 CAUSEWAY STREET
BOSTON 14, MASS.

April 4, 1957

NEDGW

SUBJECT: Survey of Pine Orchard Harbor, Branford, Connecticut

TO: Chief of Engineers, Department of the Army, Washington 25, D. C.

AUTHORITY

1. This report is submitted in compliance with an item included in Section 7 of the River and Harbor Act approved July 24, 1946, which reads as follows:

> "The Secretary of War is hereby authorized and directed to cause preliminary examination and surveys to be made at .....Harbor at Pine Orchard, Branford, Connecticut."

2. Pursuant to the above authorization, a partially favorable preliminary examination report was submitted February 24, 1956. The Division Engineer recommended that no further study be made on improvements for recreational craft at Pine Orchard Harbor at this time. He did recommend, however, a study of survey scope to determine the cost and economic justification of a Federal project for commercial navigation and to determine the amount of local participation which should be required. The Board of Engineers for Rivers and Harbors concurred with the views of the reporting officer and recommended that a survey study be made in the interests of commercial navigation.

3. A study of survey scope was assigned to the New England Division by the Chief of Engineers on July 10, 1956.

SCOPE OF STUDY

4. Extensive investigations have been made of Pine Orchard Harbor for this report. A detailed hydrographic survey, including soundings and probings was made to determine the character and volume of materials to be dredged. Studies have been made of the operation and delays associated with navigation in the existing

channel and the effect of reducing these delays. A public hearing was held at Pine Orchard on August 26, 1947. This hearing and other more recent contacts with local interests are described under Improvement Desired.

DESCRIPTION OF NAVIGATION CONDITIONS

5. Pine Orchard Harbor is located on the north shore of Long Island Sound in Branford, Connecticut, about 7 miles east of the entrance to New Haven Harbor and about 3 miles east of Branford Harbor. The harbor consists of two basins, one on the west side at the Pine Orchard Yacht Club, protected by a breakwater off Brown Point, and another on the east side at the New Haven Trap Rock Company dock. A 12-foot channel extending from the New Haven Trap Rock Company basin about 2,500 feet to deep water was constructed and has been maintained by that company. The harbor is protected by several shoals, rock outcrops and islands generally in two groups called Blackstone Rocks and the Thimbles.

6. The Pine Orchard yacht basin covers about 20 acres and is 5 to 6 feet deep. This basin and the protecting breakwater were constructed and are maintained by the Pine Orchard Club.

7. The mean range of tides at Money Island in the Thimbles is 5.6 feet. The spring range is 6.6 feet. The lowest tide to be expected is minus 2.5 feet. The locality is shown on United States Coast and Geodetic Survey charts Nos. 217 and 1212 and on the map accompanying this report.

TRIBUTARY AREA

8. The area near the harbor is the Pine Orchard section of Branford, Connecticut, an exclusive residential area of large summer homes and hotels. The single industrial activity is the shipment of trap rock by the New Haven Trap Rock Company from their dock on the eastern side of the harbor. The principal local occupation is the summer resort business. Inland from the harbor there is a small amount of farming.

9. The Branford Steam Railway, a subsidiary of the New Haven Trap Rock Company, provides freight service from their quarry in North Branford to the dock at Pine Orchard Harbor, and a connection to the Shore Line of the New York-New Haven and Hartford Railroad. Railroad and bus service are available at Branford and New Haven. The area is served by a network of good roads. No bridges cross the harbor.

PRIOR REPORTS

10. Under the present authority an unpublished preliminary examination report was submitted February 24, 1956 and reviewed by

the Board of Engineers for Rivers and Harbors. This report was favorable to a survey study of the need for improvements for commercial navigation.

11. There is no Federal navigation project authorized at Pine Orchard Harbor.

OTHER IMPROVEMENTS

12. All improvements at Pine Orchard Harbor have been accomplished by local interests. The New Haven Trap Rock Company has constructed and maintained a 12-foot channel 60 feet wide to their dock with a turning basin and berth for the shipment of crushed stone by barge. The turning basin depths range from 0 to 16 feet with 2.2 acres over 12 feet. Since 1914, the channel has been dredged by that company in 1920, 1922, 1925, 1929, 1942 and as shown below:

Date	Quantity Dredged	Expenditure	Area Dredged
Oct. 1946	28,900 cu. yds	$20,256.60	Basin and channel
March 1951	36,966 " "	25,897.20	Basin and channel
Sept. 1952	19,750 " "	15,800.00	Partial
April 1954	10,000 " "	8,000.00	Partial
March 1955	8,250 " "	8,250.00	Basin
April 1956	24,760 " "	24,760.00	Basin and channel
Total	128,626 cu. yds	$102,963.80	

13. It was stated at the 1948 hearing that dredging costs had been of the order of about one third of a million dollars since 1914.

14. The Pine Orchard Club has improved the western part of the harbor for recreational craft. Since 1924, a breakwater about 800 feet long has been constructed to shelter the yacht basin and an area of about 7 acres has been dredged to 7 feet at mean low water. The expenditures by local interests for this improvement have been about $153,000, of which $93,000 was for original work and $60,000 for maintenance dredging completed in 1951. In addition, the yacht club has constructed a club house, a dock with slips for about 20 boats, and provided mooring piles.

TERMINAL AND TRANSFERS FACILITIES

15. The New Haven Trap Rock Company dock is a pile and timber structure about 300 feet long with depths alongside of about 17 feet. On the dock is a barge loading conveyor with a loading capacity of 700 tons per hour. Crushed stone is brought to the dock from the North Branford quarry over the Branford Steam Railway and gravity dumped into the conveyor storage bins.

Mooring pile clusters have been provided in the turning basin for barges awaiting loading or a tug. There are no provisions for unloading vessels at this dock. The dock is equipped with machinery for moving the barges inside the basin, without assistance from a tug. The basin can accommodate 8 empty scows, 7 loaded scows, one scow under the chute and one tug during loading operations; and 9 empty scows, 9 loaded scows and 3 tugs overnight.

16. The Pine Orchard Club has a pile and timber dock in front of the club house. Depths alongside range from 3 to 7 feet. Gasoline, water and supplies are available to club members and guests at this dock. The club has also provided a small pile and timber pier at the inshore end of the breakwater as well as mooring piles for recreational craft.

IMPROVEMENT DESIRED

17. Authority for this study was requested by local interests who desired improvements for recreational boating. Their views were presented at a public hearing held at Pine Orchard August 26, 1948 and at a conference in 1955. The unpublished preliminary examination report submitted February 24, 1956 considered the improvements desired for recreational craft. It was the opinion of the Division Engineer that although local interests desired Federal improvement of Pine Orchard Harbor for recreational craft, (a) the benefits from such improvement would not be sufficient to justify the large expenditure required, (b) local interests should be required to make a substantial cash contribution, but town officials have indicated that such cooperation is not assured, and (c) in view of the restricted nature of property in the area it is doubtful that an adequate landing, open to the public on equal terms, could be provided near the desired anchorage. The report recommended that no further study of improvements for recreational craft be made. The Board of Engineers for Rivers and Harbors reviewed the report and concurred with the views of the Division Engineer. No further study has been made of improvements for recreational navigation.

18. In 1955, the New Haven Trap Rock Company requested a 17-foot channel to the loading basin at their dock. The company stated that the existing channel was inadequate and the tug and barge traffic to their dock was subject to serious tidal delays. In addition, it was felt that the 17-foot channel would permit the company to ship in small tramp steamers to points outside of Long Island Sound.

19. Early in 1957, the New Haven Trap Rock Company contracted to supply 750,000 cubic yards of crushed rock annually for 10 years to the New York Trap Rock Company; the rock to be shipped by barge from Pine Orchard Harbor. Because this tonnage, when added to barge shipments to other customers will bring the

annual volume through Pine Orchard Harbor to over a million tons, and because information developed during the survey study indicated that the largest tug owned by companies operating into Pine Orchard Harbor had a draft of only 15 feet, the company modified their request for improvement.

20. The company now desires a 15-foot channel to reduce the tidal delays to their prospective waterbourne shipments through Pine Orchard Harbor. In case, however, that this is found too expensive, and not economically justifiable, they requested a Federal project to maintain the present 12-foot channel.

EXISTING AND PROSPECTIVE COMMERCE

21. Shipments of crushed stone from Pine Orchard Harbor have increased steadily since World War II. Annual tonnage figures since 1943, as supplied by the New Haven Trap Rock Company are as follows:

Year	Short Tons	Year	Short Tons
1943	165,236	1950	121,865
1944	34,773	1951	174,187
1945	28,687	1952	294,545
1946	35,552	1953	356,929
1947	51,016	1954	249,807
1948	78,851	1955	398,986
1949	95,620	1956	508,584

22. The monthly shipments of trap rock since 1954 were as follows:

MONTHLY SHIPMENTS IN TONS

Month	1954	1955	1956
January	714	16,388	26,288
February	-	27,766	26,508
March	7,685	19,433	17,712
April	8,339	39,165	29,107
May	27,547	40,683	52,658
June	29,154	55,339	57,512
July	45,890	55,167	51,393
August	27,852	27,210	55,432
September	22,845	35,684	48,387
October	35,295	29,851	62,375
November	28,574	26,590	51,500
December	15,912	25,710	29,712

23. All of the above shipments have been made to various points in Long Island Sound along the coast of Connecticut, New

York City and Long Island. Very limited shipments have been made outside Long Island Sound, mostly before 1940. Following is a list of such shipments and destinations as supplied by the New Haven Trap Rock Company:

Date	Destination	Tons
1928-1932	Nantucket Island	15,000
1928-1932	Martha's Vineyard	30,000
1932-1936	Buzzards Bay	20,000
1932-1936	Wareham	15,000
1914-1938	Newport	100,000
1930-1942	Fall River	100,000
1924-1928	New Bedford	75,000
1928-1930	Tiverton	10,000
1919-1938	Providence	1,500,000
1930-1940	Taunton	10,000
1930-1940	Norwich	25,000
1930-1940	New London	75,000

24. Annual waterbourne shipments of crushed rock from Pine Orchard Harbor have increased from 36,000 tons in 1946 to 174,000 tons in 1951 and to 508,000 tons in 1956, an increase of 480 percent in the 5 year period between 1946 and 1951, and an increase of 290 percent in the 5 year period 1951 to 1956. If this type of progressive increase were to continue during the next 5 years, the increase from 1956 to 1961 would be about 200 percent, resulting in an annual volume of 1,000,000 tons in 1961. However, the New York Trap Rock Corporation has contracted to purchase 750,000 cubic yards of crushed stone annually, for a 10 year period beginning in 1958. This firm order, and shipments to other customers, will result in annual shipments of over 1,000,000 tons by barge from Pine Orchard Harbor. The New Haven Trap Rock Company has stated that present reserves in the Branford quarry will permit operation at present levels of 1.5 million tons annually for 150 to 200 years. Because of the demand for aggregates for industrial expansion and for highway construction it is considered that the area around Long Island Sound will require increasing volumes of crushed trap rock over the next 50 years. It is expected that the present relationship between barge rates and other shipping methods will not change materially during this period. On this basis it is estimated that barge shipments of trap rock from Pine Orchard Harbor will average at least 1,000,000 tons annually during the 50-year period from 1960 to 2010.

VESSEL TRAFFIC

25. The local recreation fleet consists of about 100 sail and power boats ranging in length from 14 to 50 feet, but all of these have sufficiently low drafts not to realize any direct benefit from the desired improvement. No recreational craft use the loading basin or the approach channel.

26. The New Haven Trap Rock Company loads over 500 barges annually at present, each barge having an average capacity of about 750-tons. On the basis of 850 round trips made by barges in 1954 and 1955, a percent distribution was computed of scow-trips and draft as shown below:

Draft	7'	7.5'	8'	8.5'	9'	9.5'	10'	10.5'	11'	11.5'
% of Total Scow-Trips	0.5%	0%	1.5%	4.0%	2.5%	5.5%	72.0%	3.5%	5.5%	5.0%

27. A similar analysis was made of 1,262 tug round-trips in 1954, 1955 and 1956 with results as follows:

Draft	8'	9'	10'	11'	12'
% of Total Tug-Trips	3%	5%	16%	26%	50%

28. Some of the companies that operate tugs into Pine Orchard Harbor own tugs over 12-foot draft. Available data indicate three such tugs, one 13-ft., one 14-ft. and one 15-ft. draft, none of which has been reported to have made trips into Pine Orchard Harbor during 1954, 1955, and 1956.

29. Empty barges are brought in by tug boats, which usually do not wait, but come back later for a tow. The maximum number of scows which have been towed by a single tug into Pine Orchard Harbor was reported to have been 13. Study of recent records indicates that a tug makes a trip to Pine Orchard for every 700 tons of rock shipped from the harbor, and that the average barge load is 760 tons. The average tow is 1.85 barges.

DIFFICULTIES ATTENDING NAVIGATION

30. The difficulties attending navigation in the commercial channel are those attendant upon tidal operation of tugs with barges in the present narrow channel. There is no detailed information available on accidents and damage to vessels. It was stated at the 1948 hearing, however, that such damages amount to several hundred dollars annually. In July 1956, the 11-foot draft tug "Stamford" was delayed half a day and almost overturned when it went aground at the edge of the channel.

WATER POWER AND OTHER SPECIAL SUBJECTS

31. There are no matters of water power, flood control or pollution pertinent to this report.

PLANS OF IMPROVEMENT

32. The New Haven Trap Rock Company desires a 15-foot channel from their loading basin at Pine Orchard to deep water in Long Island Sound to eliminate tidal delays and navigation difficulties to present and prospective tug and barge traffic. The company indicated that in the event that a deeper channel was not justified, a Federal project for a 12-foot channel was desired.

33. Traffic in the present channel is subject to tidal delay as well as delay and risk of grounding due to the inadequate channel width. A 15-foot deep channel would permit all of the present traffic of tugs up to 12-foot draft to operate with a safe clearance and without tidal delay. It is considered that provision of a 100-foot wide channel would substantially reduce the delay and hazard due to the present inadequate width. The present loading basin with 2.2 acres over 12 feet deep is not considered adequate for the prospective future volume of traffic, particularly if the channel is improved. Because it is desirable to permit tugs to stay in the basin during periods of low tide, the basin should be maintained to a depth of at least 15 feet, if either a 12 foot or 15 foot channel is provided. The plans of improvement considered in this report would provide a channel and loading basin as follows:

a. Channel: 15 feet deep, 100 feet wide, 4,500 feet long.
Loading basin: 3.2 acres, 15 feet deep.

b. Channel: 12 feet deep, 100 feet wide, 2,500 feet long.
Loading basin: 3.2 acres, 15 feet deep.

SHORE LINE CHANGES

34. Pine Orchard Harbor, in Branford, Connecticut is located in a very irregular section of the Connecticut coastline that is generally composed of resistant rock with numerous pocket beaches between rocky points. The channel dredging desired by local interests would have no significant effect on the adjacent shore line.

REQUIRED AIDS TO NAVIGATION

35. The United States Coast Guard has been consulted and has advised that additional aids to navigation will be required. For both plans of improvement it was estimated that 4 additional buoys would be required at a first cost of $2,000. The annual maintenance cost for aids to navigation for this plan was estimated at $200.

ESTIMATES OF FIRST COST

36. Estimates of first cost have been prepared for the two plans of improvement considered in this report. Probings were made

in the hydrographic survey to determine the relative hardness of the material to be dredged and the existence and extent of submerged rock areas. There were no indications of rock in any of the areas considered and all proposed dredging would be of ordinary material consisting of mud and sand. Dredging quantities are in terms of in-place measurement and provide for dredging to the particular depth plus an allowance of one foot overdepth. Side slopes of 1 vertical on 3 horizontal were used. Unit prices are based on prices prevailing in March 1957 and on removal of material by contract dredging. Federal construction costs are based on construction and maintenance of the channel and Non-Federal costs are based on enlarging and maintaining the loading basin. The estimate of first cost of construction for the improvement is presented below:

PLAN OF IMPROVEMENT	15-foot Channel	12-foot Channel
Federal Construction Cost		
Corps of Engineers: Dredging Channel		
Volume of material to be removed	78,000 cy	16,000 cy
Estimated unit cost	$1.60/cy	$2.25/cy
Construction contract cost	$125,000	$35,000
Contingencies	15,000	5,000
Engineering and Design	4,000	1,000
Supervision and Administration	6,000	4,000
Total	$150,000	$45,000
Coast Guard:		
Additional aids to navigation	2,000	2,000
TOTAL FEDERAL CONSTRUCTION COST	$152,000	$47,000
Non-Federal Construction Cost		
Local Interests: Dredging 15-foot Loading basin, 3.2 acres		
Volume of material to be removed	20,000 cy	20,000 cy
Estimated unit cost	$1.60/cy	$2.25/cy
TOTAL NON-FEDERAL CONSTRUCTION COST	$30,000	$45,000
TOTAL PROJECT CONSTRUCTION COST (March 1957)	$182,000	$92,000

ESTIMATES OF ANNUAL CHARGES

37. Estimates of annual charges have been made for both considered plans of improvement. Maintenance costs are based on volumes dredged from the existing channel and basin during the

past few years. The estimated volume of annual maintenance dredging which will be required in the present and considered improvements are shown below:

	Volume in Cubic Yards	
	Channel	Basin
Present 12'x60' channel and 10' to 17' basin	4,000	4,000
12'x100' channel 2,500 feet long and 15' basin	6,000	5,000
15'x100' channel 4,500 feet long and 15' basin	11,000	5,000

38. Annual charges are based on an allocation of costs to local interests (a single beneficiary) of 50 percent of the total project construction cost. Annual charges on Federal investment have been computed with an interest rate of 2-1/2 percent and a project life of 50 years, with Federal maintenance of the channel. Annual charges on Non-Federal investment have been computed with an interest rate of 4 percent and a project life of 50 years, with local interests maintaining the loading basin. Annual maintenance costs are computed on the basis of probable maintenance dredging every three years at a unit cost of $2.00/cubic yard.

PLAN OF IMPROVEMENT	15-foot Channel	12-foot Channel
Federal Investment		
Corps of Engineers:		
Channel Dredging	$90,000	$45,000
Coast Guard:		
Aids to navigation	2,000	2,000
Total Federal Investment	$92,000	$47,000
Non-Federal Investment		
Local Interests:		
Cash contribution	$60,000	0
Dredging loading basin	30,000	45,000
Total Non-Federal Investment	$90,000	$45,000
TOTAL INVESTMENT COST	$182,000	$92,000
Federal Annual Charges		
Corps of Engineers:		
Interest on investment (2-1/2%)	$ 2,300	$ 1,100
Amortization (50 yr. life)	900	500
Maintenance of Channel	22,000	12,000
Total	$ 25,200	$13,600

TOTAL INVESTMENT COST	15-foot Channel	12-foot Channel
Coast Guard:		
Interest on investment (2 1/2%)	$ 50	$ 50
Amortization (50 years)	20	20
Maintenance of Aids to Navigation	220	220
Total	$ 290	$ 290
NON-FEDERAL ANNUAL CHARGES		
Local Interests:		
Interest on investment (4%)	$ 3,600	$ 1,800
Amortization (50 years)	600	300
Maintenance of loading basin	10,000	10,000
Total	$14,200	$12,100
TOTAL ANNUAL CHARGES		
Federal:		
Corps of Engineers	$25,200	$13,600
Coast Guard	300	300
Total	$25,500	$13,900
Non-Federal:		
Local interests	$14,200	$12,100
Total	$39,700	$26,000

ESTIMATES OF BENEFITS

39. The present improvement at Pine Orchard Harbor was constructed and has been maintained by the New Haven Trap Rock Company to permit economical shipment of crushed rock to points on Long Island Sound. Loading barges at Pine Orchard have made possible large savings in transportation costs over the cheapest alternative route. However, the tugs and barges now used for this traffic are subject to tidal delays and the risk of grounding on the sides of the present 12-foot deep, 60-foot wide channel. Reasonably prospective future traffic would be subject to similar difficulties as well as delays from congestion in the present 2.2 acre loading basin. The plans of improvement considered in this report would reduce the cost of transporting crushed rock through Pine Orchard Harbor by eliminating these difficulties.

40. A study has been made of the present improvement at Pine Orchard Harbor to determine the need for continued maintenance of the existing channel and basin. A breakdown of tonnages and of shipping rates to various locations in 1955 (Shown in Table 1) indicates that transportation costs from the Branford quarry, by barges

loaded at Pine Orchard, to the ports of destination ranged from $0.70 to $1.15 per ton. The mean transportation cost was $0.83 per ton for the 1955 tonnage.

41. Shipment by the cheapest alternate route, either by rail or by truck to New Haven and by barge from there, would have increased the mean transportation cost to $1.26 per ton for the 1955 tonnage. The cost differential of $0.43 per ton is considered to be the saving made possible by the present channel and basin. That saving was $170,000 in 1955 and for the prospective average commerce of 1,000,000 tons over the next 50 years would be $430,000 annually.

42. Although construction of a Federal navigation project at Pine Orchard Harbor would also assure the continued future saving possible by use of the harbor instead of the cheapest alternate route for transportation of crushed rock, it is considered that the present improvement would be maintained by the New Haven Trap Rock Company, and the future use of the harbor assured, even if a Federal improvement is not constructed. The present and prospective saving by use of the harbor over the cheapest alternate route, therefore, is not considered to be a benefit to the considered improvements.

43. The wider channel and larger basin in both of the plans of improvement considered will permit higher towing speeds in the channel, reduce the tug turn around time in the basin, and eliminate the present risk of groundings. The time now required for a tug to travel from deep water to the loading basin and back to deep water is reported to vary from 45 minutes to one hour, depending on whether the tug is bringing in empties or taking out loaded barges. It is considered that this time would be reduced because of the higher safe speeds and shorter turn around time made possible by the 100-foot wide channel and larger loading basin in either plan of improvement. It is also considered that time losses presently incurred due to channel inadequacy and barge grounding would be materially reduced. On the basis of prospective future traffic of 1,000,000 tons of stone, which would require an average of 1,430 tug trips annually, and tug operating costs of $20 per hour, it is considered that vessel operating costs would be reduced by $2,000 annually by either of the considered plans of improvement.

44. Only one specific accident in the present channel has been reported, the grounding of the tug "Stamford" on the edge of the channel in July 1956, and no data is available to permit a precise evaluation of the hazard of operation in the present channel. The tug "Stamford" would have overturned had it not been possible to use the two empty barges which she was towing. Otherwise, damage to the tug would have been extensive. Although no precise evaluation of the benefit from reduction of the risk of operation

TABLE 1

ESTIMATE OF MEAN UNIT COSTS OF SHIPMENTS OF CRUSHED ROCK THROUGH PINE ORCHARD HARBOR

vs.

ALTERNATE ROUTES

Destination of Shipments	Distribution of Shipments (1955)	Unit Cost of Shipment ($/ton) Via Pine Orchard (1)	Via New Haven (2)	Via Rail (3)	Cost Distribution per ton Shipment Via Pine Orchard	Via Cheapest Alternate Route
Bridgeport, Conn.	0.10	0.70	1.30	0.70	0.07	0.07
Norwalk, Conn.	0.04	0.80	1.40	0.80	0.03	0.03
Stamford & Greenwich, Connecticut	0.08	0.85	1.45	0.90	0.07	0.07
Port Chester, N.Y.	0.03	0.85	1.45	0.95	0.03	0.03
Metropolitan New York	0.04	0.90	1.50	1.20	0.04	0.05
New Jersey	0.02	0.90	1.50	1.20	0.02	0.02
Hempstead Hbr., N.Y.	0.35	0.85	1.45	2.95	0.30	0.51
Oyster Bay & Huntington, New York	0.20	0.75	1.35	2.95	0.15	0.27
Port Jefferson, N.Y.	0.09	0.75	1.35	3.30	0.07	0.12
Mattituck, N.Y.	0.03	1.15	1.75	3.30	0.03	0.05
Plum I. & Fishers I., New York	0.02	1.15	1.75	----	0.02	0.04
	1.00				$0.83	$1.26

(1) Actual 1955 shipment cost from Branford quarry via rail to Pine Orchard and barge to destination.
(2) Actual 1955 shipment cost from Branford quarry via truck to New Haven and barge to destination.
(3) Actual 1955 shipment cost from Branford quarry via rail to destination.

because of the wider channel of the considered plans of improvement is possible, in the best judgment of the reporting officer it is about $2,000 annually.

45. In addition to the reduction in operating costs because of the wider channel, construction of the 15-foot channel and loading basin would eliminate all tidal delays to the tugs and barges now used at Pine Orchard. Tidal delays which would occur in the considered 12-foot channel have been estimated on the basis that the existing proportions of various draft tugs and scows will not change appreciably in the future, that the tug operators will not use the channel with less than 3 feet clearance under the tug or with less than 2 feet under the towed scows, and that the travel time in the considered channel is .25 hours.

46. Prospective future commerce of 1,000,000 tons of rock annually over the life of the project will require an average of 1,430 tug trips yearly. The number of tugs of various drafts and the delays which would occur in the considered 12-foot channel are shown below:

Tugs Expected		Hours of Delay	
No.	Draft	Average	Total
40	8	0	0
70	9	0	0
230	10	0.5	115
370	11	1.1	407
720	12	1.8	1,296
1,430			1,818

47. The operating cost for a tug is $20 per hour. The operating cost for the scows which would be delayed each time a tug is delayed is $3.70 per hour (an average of 1.85 scows at $2.00 per hour). The total operating cost of $23.70 of the 1,818 hours of delay time represents an annual cost of $43,000 which would occur in the considered 12-foot channel but would be eliminated by the 15-foot channel. There is a small probability that some additional delays would occur in the considered 12-foot channel if a light draft tug was delayed because of the tide needed for a deeper draft scow. The cost of this delay has not been estimated.

48. It is considered improbable that material land enhancement benefits would be realized. Past experience has shown that dredging of the present channel is more often done by bucket dredge than by hydraulic dredge. In view of the long channel length directly offshore, an unusually long pontoon pipeline would

be required. There would be no apparent economy to the hydraulic dredging method in this situation, and, therefore, no reason to require that spoil disposal areas be furnished. Such dredging as might be done by hydraulic dredge, such as the inner basin, in the improbable event that the contractor put both types of dredges on the job, could not be reliably considered to result in land enhancement. The Trap Rock Company has no need or use for made land in the shore marsh areas, nor is it likely that residential use could be anticipated in the immediate vicinity of this stone shipping operation. At this time there is no indication of other industrial development in this area of sufficient reliability to warrant assigning any direct benefit therefrom.

49. It is considered that benefits from elimination of navigation hazards and tidal delays would reduce the transportation cost to the consumers and are, therefore, general benefits. The benefits from construction of either of the considered plans of improvement are summarized below:

	15-foot Channel	12-foot Channel
From reduced vessel lost time and operating time because of the wider channel	$ 2,000	$ 2,000
From reduction of the navigation hazard of operating in the present channel	2,000	2,000
From elimination of tidal delays to tug and barge traffic	43,000	0
TOTALS	$47,000	$ 4,000

COMPARISON OF BENEFITS AND COSTS

50. The benefits summarized above are the incremental benefits for each improvement in addition to the benefits provided by the present channel and basin at Pine Orchard Harbor. The New Haven Trap Rock Company constructed and, if no improvement is made, would no doubt continue to maintain the present channel and basin. It is considered that the first cost of constructing the present improvement has already been amortized so that the future maintenance cost represents the total annual cost of the present improvement. Based on past maintenance figures it is considered that future maintenance of the existing channel and basin would require dredging about 8,000 cubic yards at an average cost of $16,000 annually. The incremental annual cost of the considered plans of improvement is taken as the additional annual costs of the improvement over the annual costs of the present channel and basin.

51. The incremental annual costs, annual benefits, and the benefit-cost ratio for the considered plans of improvement are shown below:

	15-foot Channel	12-foot Channel
Total project annual charges	$39,700	$26,000
Annual charges of present improvement	16,000	16,000
Incremental annual charges	$23,700	$10,000
Incremental annual benefits	$47,000	$ 4,000
Benefit-cost ratio	2.0	0.4

52. It should be noted that the benefit-cost ratio for enlarging and deepening the present channel and basin to 15 feet is favorable, but that the considered plan of improvement to widen the 12-foot channel is not economically justified.

53. Benefits and costs have also been evaluated for continued maintenance of the existing channel and basin at Pine Orchard. Improvement and maintenance of the harbor by local interests yielded a reduction of transportation costs over the cheapest alternate route of $170,000 in 1955. The estimated average tonnage for the next 50 years would show a similar saving of $430,000 annually. The estimated future annual cost of maintaining the existing improvement is $16,000; yielding a benefit-cost ratio of 26.9 for continued maintenance of the present channel and basin.

PROPOSED LOCAL COOPERATION

54. Local interests should be required to hold and save the United States free from damages that may result from construction and maintenance of the improvements. It is probable that the State of Connecticut will, in accordance with established practice, provide the necessary assurances when requested.

55. The New Haven Trap Rock Company should be required to enlarge and maintain the loading basin adjacent to its dock facilities to a depth of 15 feet. The estimated annual maintenance cost is $10,000. Present dock facilities appear to be adequate and it is expected that these facilities will be expanded to meet future needs as they develop.

56. An apportionment of cost has been made on the basis that the New Haven Trap Rock Company will enlarge their loading basin to about 3.2 acres, 15 feet deep, and make a cash contribution of 40 percent of the construction of the Federal channel. The present estimated cost to the New Haven Trap Rock Company is $30,000 for enlarging the loading basin and $60,000 for the cash contribution, a total of $90,000, which is 50 percent of the total cost of the desired improvement.

57. The New Haven Trap Rock Company has been consulted and has agreed to the above requirements of local cooperation.

APPORTIONMENT OF COSTS AMONG INTERESTS

58. The benefits from the desired improvement are from reduction in transportion costs by elimination of delays to commercial navigation and are expected to accrue to the general public. However, the New Haven Trap Rock Company is the single shipping interest presently expected to use the waterway, and it is considered that the company as a single beneficiary should contribute 50 percent of the cost of the improvement. Based on the present cost estimate of $180,000 to construct the project (exclusive of aids to navigation) the local share would be $90,000. It is further considered that the dredging necessary to enlarge the loading basin is properly a local responsibility. The local share of the costs of the desired improvement have, therefore, been divided between the estimated cost of enlarging the loading basin, $30,000, and a cash contribution toward construction of the Federal channel, $60,000, which amount is 40 percent of the cost of construction of the channel. The costs of the improvement have, therefore, been apportioned on the basis that the New Haven Trap Rock Company will enlarge their loading basin and make a cash contribution of 40 percent of the cost of the channel. Maintenance of the basin is considered a local responsibility.

COORDINATION WITH OTHER AGENCIES

59. All Federal, State and local interests having interest in the improvement of Pine Orchard Harbor were notified of the public hearing held at Pine Orchard, Branford, Connecticut, on 26 August 1948. Representatives of the New Haven Trap Rock Company, officials of the Town of Branford and of the Pine Orchard Yacht Club, other local interests, the U. S. Fish and Wildlife Service, and the U. S. Coast Guard have all been consulted during the study concerning the effects of the proposed improvements on their activities.

DISCUSSION

60. Pine Orchard Harbor, in Branford, Connecticut on Long Island Sound about 7 miles east of New Haven, is a small harbor used by the recreational fleet of the Pine Orchard Club and tugs and barges transporting crushed stone from the New Haven Trap Rock Company dock. Local interests have dredged an anchorage area for recreational craft, constructed a breakwater, and provided mooring piles and docking facilities. The New Haven Trap Rock Company maintains a 12-foot deep, 60-foot wide channel to their loading basin at the head of the harbor.

61. At the public hearing in 1948, local interests represented by the Pine Orchard Club, desired improvement of the harbor for recreational craft. The desired improvements were considered by the Division Engineer in the preliminary examination report submitted February 24, 1956. That report concluded that a Federal navigation project for recreational craft was not warranted. The Division Engineer recommended that no further study be made of improvements for recreational navigation. The Board of Engineers for Rivers and Harbors concurred with the recommendation of the Division Engineer.

62. In 1955, the New Haven Trap Rock Company requested a Federal project to provide a deeper channel to their loading basin to reduce tidal delay expenses of the tugs and barges now used for the shipment of about 500,000 tons of crushed stone annually. Stone from their quarry in North Branford is brought to the dock by the Branford Steam Railway, a subsidiary company, to be loaded onto barges. The company sells crushed stone at the dock, or ships it by barge, to contractors and construction jobs in southern New England and New York. The trap rock shipped from Pine Orchard is used as concrete aggregate and for road building in the Long Island Sound area because of the relative lack of suitable natural gravel in the area. The prospective future commerce over the next 50 years is conservatively estimated at an average of 1,000,000 tons of crushed rock annually.

63. Two plans of improvement for commercial navigation at Pine Orchard Harbor have been considered. Each would provide a 100-foot wide channel and a 3.2 acre loading basin at the dock of the New Haven Trap Rock Company, roughly on the alignment of the existing improvements.

64. The desired 15-foot channel and basin is economically justified, with a benefit-cost ratio of 2.0. The first cost of this improvement is estimated at $150,000 for dredging the proposed Federal channel, $2,000 for additional navigation aids, and $30,000 for dredging of the loading basin by local interests. The annual maintenance costs are estimated at $22,000 for the Federal channel, $200 for navigation aids, and $10,000 for the loading basin. Total annual charges for the project would be $39,700 and the incremental annual charges for the improvement (the difference between the total project annual charges and the estimated $16,000 annually necessary to maintain the present improvement) is $23,700.

65. Annual benefits from the desired 15-foot channel are estimated to be $2,000 from reduction of the present navigation hazard, $2,000 from reduction of navigation costs incurred by operation in the present narrow channel and basin, and $43,000 from elimination of tidal delays to present and prospective tug

and scow traffic because of deepening the channel from 12 to 15 feet and widening it from 60 to 100 feet. The total annual benefits of $47,000 and incremental annual charges of $23,700 indicate a benefit-cost ratio of 2.0 for the desired improvement.

66. Study of the 12-foot considered improvement indicated benefits from reduction of navigation hazards of $2,000, and from reduction of vessel operation costs of $2,000, a total of $4,000. The total project annual charges would be $26,000 and the incremental annual charges for this improvement are $10,000. This improvement would have a benefit-cost ratio of 0.4, and is not economically justified.

67. Benefits were also evaluated for the present improvement at Pine Orchard Harbor. It appears that annual savings in transportation costs over the cheapest alternate route were about $170,000 in 1955, and over the next 50 years would average $430,000 annually. A large proportion of this amount accrued to the users of the crushed stone shipped from Pine Orchard and is considered to be a general benefit. The continued expenditure of an estimated $16,000 annually by local interests to maintain the present improvement would assure this benefit. The value of the business gained by the New Haven Trap Rock Company because of the availability of the present improvement is certainly sufficient to justify their continued maintenance of the present 12-foot channel if the harbor is not improved, while the general benefits from the desired 15-foot channel and from the existing channel are considered to be more than sufficient to justify a Federal project for improvement.

68. The benefits from the desired improvement are transportation savings accruing from reduced operating costs of commercial navigation. However, the vessel traffic in the improved waterway will consist solely of the tugs and barges to the dock of the New Haven Trap Rock Company. An apportionment of costs between interests has, therefore, been made so that the non-Federal share of the construction cost would be 50 percent of the total project construction cost. Based on the present estimate of $180,000 for construction of the project exclusive of aids to navigation, the local share would be $90,000, of which $30,000 is the cost of dredging the loading basin. The remaining $60,000 is 40 percent of the present estimated cost of the channel.

69. It is considered that the New Haven Trap Rock Company, as the only shipper expected to use the waterway, should be required to enlarge and maintain their loading basin and make a cash contribution of 40 percent of the cost of the Federal channel. The annual cost for maintaining the loading basin is estimated at $10,000. The New Haven Trap Rock Company has been consulted and has agreed to enlarge and maintain the loading basin and provide the necessary cash contribution.

70. In addition, local interests should be required to hold and save the United States free from all damages that may result from the project. It is expected that the State of Connecticut will provide the necessary assurances when required.

71. The U. S. Department of Fish and Wildlife has been consulted on the effect of the desired improvement on fish and wildlife and has advised that Fish and Wildlife interests have no adverse comment to offer.

CONCLUSIONS

72. Construction and maintenance of the present channel at Pine Orchard by local interests has provided large general navigation benefits by reducing transportation costs for shipment of crushed rock to points around Long Island Sound. The volume of this traffic is now about 500,000 tons yearly, and it is expected to average about 1,000,000 tons annually over the next 50 years. The character of the tugs and scows now used at Pine Orchard, and delayed by tidal operation, is not expected to change materially in the future.

73. A Federal navigation project is justified to provide the desired improvement at Pine Orchard Harbor, Branford, Connecticut. The improvement would consist of a 15-foot deep channel, 100 feet wide and about 4,500 feet long, from deep water in Long Island Sound to the loading basin of the New Haven Trap Rock Company. As the only shipper expected to use the waterway, that company should be required to share in the cost of the improvement to the extent of 50 percent of the construction cost.

74. The total first cost of the improvement is estimated (March 1957) at $182,000; $150,000 to construct the 15-foot channel, $30,000 to enlarge the loading basin and $2,000 to provide additional aids to navigation. Annual maintenance costs are estimated at $22,000 for the channel, $10,000 for the basin and $200 for the additional navigation aids. The incremental annual charges for the desired improvement are estimated at $23,700, the benefits from reduced navigation costs are $47,000 and the benefit-cost ratio is 2.0 to 1.

75. It is considered that because the New Haven Trap Rock Company is the only shipper presently expected to use the waterway, that company should be required to contribute 50 percent of the cost of construction of the project. An apportionment of costs has been made on that basis. The Federal cost of the project is estimated at $90,000, plus the cost of additional navigation aids estimated to cost $2,000. The non-Federal cost of

the project is estimated at $90,000, of which $30,000 is the estimated cost of enlarging the loading basin. The necessary cash contribution of 40 percent of the cost of the Federal channel construction is now estimated at $60,000.

76. The New Haven Trap Rock Company has been consulted and has agreed to enlarge and maintain the loading basin and contribute in cash 40 percent of the Federal construction cost. Local interests should also be required to hold and save the United States free from damages resulting from the construction and maintenance of the project. It is expected that local interests will provide the necessary assurances when requested.

77. A considered alternate plan of improvement to widen to 100 feet the present 12-foot channel and enlarge the loading basin would have a first cost of about $92,000, incremental annual charges of $10,000, and would yield benefits from reduced navigation costs of about $4,000. The resulting benefit-cost ratio of 0.4 indicates that this considered improvement is not justified.

RECOMMENDATIONS

78. It is recommended that a Federal navigation project be authorized at Pine Orchard Harbor, Branford, Connecticut to provide for a channel 15 feet deep, 100 feet wide from deep water in Long Island Sound to the New Haven Trap Rock Company loading basin. The estimated (March 1957) Federal first cost is $90,000 for construction of the channel and $2,000 for additional navigation aids, with $22,000 annually for maintenance of the channel and $200 for maintenance of the navigation aids. The authorization should be subject to the requirements that the New Haven Trap Rock Company contribute 40 percent of the construction cost of the proposed Federal channel project and enlarge and maintain their loading basin to 3.2 acres at a depth of 15 feet. Local interests should also be required to hold and save the United States free from damages resulting from the construction and maintenance of the project.

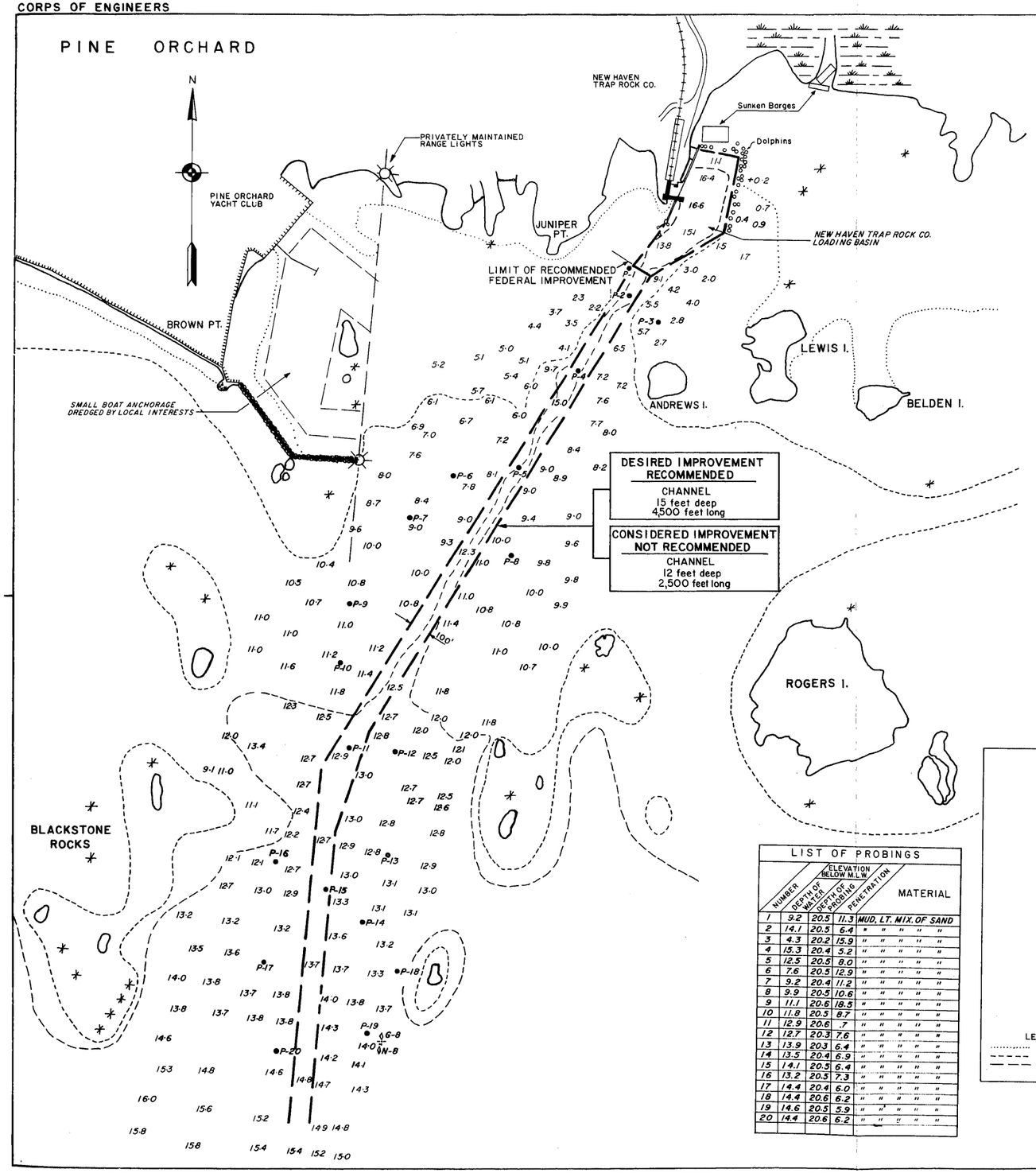
Incl:
Map of Pine Orchard Harbor

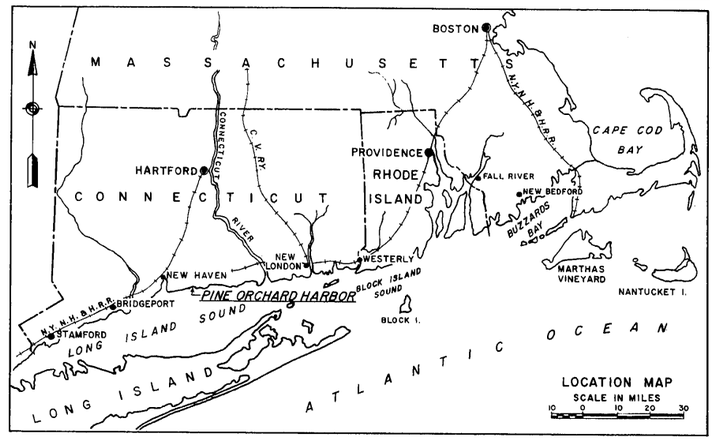
ROBERT J. FLEMING, JR.
Brigadier General, U. S. Army
Division Engineer

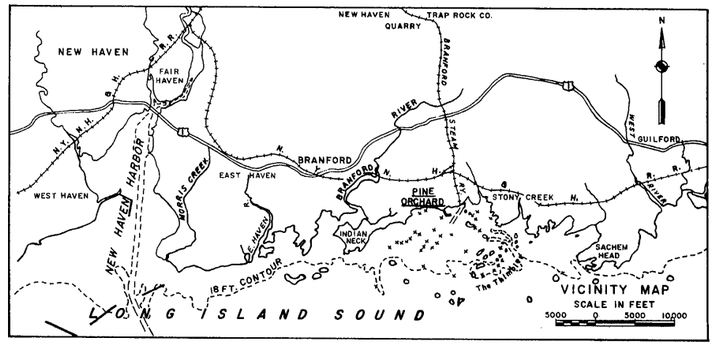
CORPS OF ENGINEERS

U.S. ARMY

PINE ORCHARD







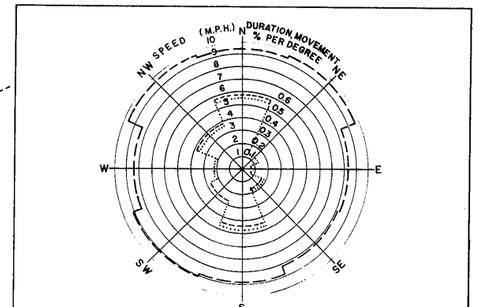
NOTES:

Soundings and probings are in feet and tenths and are referred to the plane of Mean Low Water. Hydrography from survey of Oct.-Nov. 1956 by H.A. Fishlock. Topography from U.S.C.&G.S. Coast Charts and maps supplied by the New Haven Trap Rock Co.

Mean Low Water shown thus .....
6-ft. depth contour shown thus ----
12-ft. depth contour shown thus — — —
Limits of desired improvements shown thus ——————
Probings shown thus ● P-1
Probings were taken with a 3/4 inch iron pipe forced down by one man.

LIST OF PROBINGS

NUMBER	DEPTH OF WATER C.R.	ELEVATION BELOW M.L.W. DEPTH OF PROBING	PENETRATION	MATERIAL
1	9.2	20.5	11.3	MUD, LT. MIX. OF SAND
2	14.1	20.5	6.4	" " " " "
3	4.3	20.2	15.9	" " " " "
4	15.3	20.4	5.2	" " " " "
5	12.5	20.5	8.0	" " " " "
6	7.6	20.5	12.9	" " " " "
7	9.2	20.4	11.2	" " " " "
8	9.9	20.5	10.6	" " " " "
9	11.1	20.6	18.5	" " " " "
10	11.8	20.5	8.7	" " " " "
11	12.9	20.6	.7	" " " " "
12	12.7	20.3	7.6	" " " " "
13	13.9	20.3	6.4	" " " " "
14	13.5	20.4	6.9	" " " " "
15	14.1	20.5	6.4	" " " " "
16	13.2	20.5	7.3	" " " " "
17	14.4	20.4	6.0	" " " " "
18	14.4	20.6	6.2	" " " " "
19	14.6	20.5	5.9	" " " " "
20	14.4	20.6	6.2	" " " " "



PINE ORCHARD HARBOR
BRANFORD, CONN.

IN 1 SHEET 200 0 200 400 SCALE IN FEET

NEW ENGLAND DIVISION, BOSTON, MASS.

APPROVED
CHIEF, ENGINEERING DIVISION

APPROVED
COL., C.E. DIVISION ENGINEER

SUBMITTED
CHIEF, COASTAL SURVEYS BRANCH — DR BY ADC
CHIEF, HYDRAULICS AND HARBOR SEC. — TR BY ADC
PROJECT ENGINEER — CH BY

TO ACCOMPANY SURVEY REPORT
DATED APRIL 4, 1957

FILE NO. P.O.5